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SOUTHEAST ASIA MOSQUITO PROJECT

B. de Meillon, et al

Smithsonian Institution

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SOUTHEAST ASIA MOSQUITO PROJECT

Final Report

B. de Meillon and E. L. Peyton

January 30, 1975

For the period October 1, 1964 to May 31, 1974

Supported by

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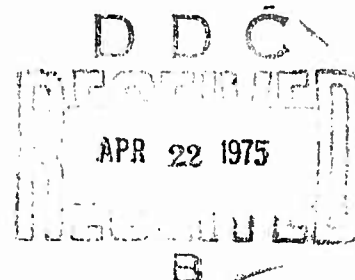
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of identification keys and training courses. Over 200,000 specimens were accessioned by the project. A large proportion of this material will be incorporated into the collections of the Smithsonian Institution.

In the final year of the project significant research was reported on several subgenera of Aedes, the subgenus Anopheles, the subgenus Culex and the genus Uranotaenia. It is anticipated that monographs of several of these groups will be completed before the end of 1975

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SUMMARY

Studies conducted on the mosquito fauna of Southeast Asia over a ten year period were summarized in 101 publications which included 19 monographs. These are cited in Appendix 3. Eighty species and two subgenera were described as new. Several hundred previously known but poorly described species have been redescribed and illustrated in the above monographs. Procedures were developed for the recognition of the more important vectors of malaria and arbovirus disease from Southeast Asia and these were made available to field personnel through the preparation of identification keys and training courses. Over 200,000 specimens were accessioned by the project. A large proportion of this material will be incorporated into the collections of the Smithsonian Institution.

In the final year of the project significant research was reported on several subgenera of Aedes, the subgenus Anopheles, the subgenus Culex and the genus Uranotaenia. It is anticipated that monographs of several of these groups will be completed before the end of 1975.

INTRODUCTION

The importance of mosquitoes as vectors of human diseases in Southeast Asia has been appreciated since the early part of this century. Despite this, there has never been a comprehensive study of the mosquitoes of this area. Extensive work has been done on some groups of mosquitoes, and rather intensive studies have been made in limited geographical areas such as the Malayan peninsula, but much of the data was fragmentary and out of date in view of modern biosystematic concepts. The experience with malaria, dengue and other mosquito-borne diseases during World War II military operations in Southeast Asia provided dramatic evidence of the military importance of these insect vectors. The current widespread distribution of drug resistant falciparum malaria and hemorrhagic dengue fevers within the subject area has provided added impetus for a thorough knowledge of the mosquitoes of Southeast Asia. In order to control effectively these disease vectors it would first be necessary to complete a thorough study to determine the species of mosquitoes present in the area and to develop reliable methods for recognizing these species.

Beginning in 1961, a major study of the mosquito fauna of Thailand was undertaken by the U. S. Army Medical Component, Southeast Asia Treaty Organization (SEATO), Bangkok. It became evident that a major revision of the entire mosquito fauna of the entire area would be needed, which was beyond the capability of the SEATO laboratory. The formulation of such a faunal study was the subject of discussions held by prominent mosquito workers from both the U. S. and abroad at the British Museum (Natural History), London during the 11th International Congress of Entomology in August 1964. It was the consensus of these entomologists that such a project could best be conducted at the National Museum of Natural History, Smithsonian Institution, Washington, D. C. under the auspices of a U. S. Army Medical Research and Development Command (USAMRDC) Contract. The Department of Entomology, Smithsonian Institution was selected as the most appropriate organization due to their interest in the project, the presence of extensive mosquito collections and the active participation of competent mosquito taxonomists from the Systematic Entomology Laboratory, U. S. Department of Agriculture and the Walter Reed Army Institute of Research. Through a contract with the USAMRDC, the project was inaugurated in October 1964 as the Army Mosquito Project under the technical guidance and supervision of Dr. Alan Stone as Principal Investigator.

The contract was initiated as a cooperative Smithsonian and U. S. Army project to make a definitive study of the mosquito species present in Southeast Asia¹, to include illustrations and descriptions of adult

1

Southeast Asia is defined as including the following countries: Bangladesh, Andaman Islands, Burma, Thailand, Cambodia, Laos, North and South Vietnam, Malaysia, Singapore, China south of the Yangtze River, Taiwan, Southern Ryukyu Islands, Philippines and Indonesia.

and immature stages, taxonomic keys, ecological and biological information on each species, and where pertinent, specific detailed information concerning the role of each species, in the transmission of human and/or animal disease. In addition, the project entailed the assembly of available information on the mosquito fauna of this region, study and evaluation of the specimens present in the U. S. National Museum, the British Museum (Natural History), other similar institutions and field collections as required to provide additional study material. Plans were made to publish this work in sections, as completed in order that the information be made available to interested workers as soon as possible. An ultimate goal of this initial contract was the preparation and publication of a definitive book on the mosquitoes of Southeast Asia.

At an early stage in the project, it became obvious that the small number of resident entomologists (Appendix 1) could only deal with a small fraction of the mosquito fauna which was estimated to comprise 800+ species. For this reason, the project, which had changed its name to Southeast Asia Mosquito Project (SEAMP) decided to enlist the services of consultants to deal with groups which the SEAMP staff could not handle. (Appendix 2). Through the efforts of these consultants, a number of significant taxonomic studies were completed which could not be undertaken by the resident staff. Associated with the extra-mural group, several hundred plates were prepared by skilled Japanese scientific illustrators at the 406th Medical General Laboratory under the supervision of LTC Hugh L. Keegan, LTC Vernon J. Tipton, LTC Alexander A. Hubert and CPT Edward S. Saugstad from 1964 to 1974.

The work of SEAMP was published through two channels. The first consisted of short articles announcing the discovery of new species, new synonymies, distribution and systematic arrangements. Such articles were submitted for publication in various entomological journals that offered rapid publication. A second comprised major works dealing with genera, subgenera or species groups in a complete and uniform manner as regards format, illustration and description. These works were published by the American Entomological Institute in its Contributions series as a group of definitive studies entitled "Contributions to the Mosquito Fauna of Southeast Asia, I-XIX" (Appendix 3).

PRINCIPAL SCIENTIFIC ACCOMPLISHMENTS

The principal achievements of the Southeast Asia Mosquito Project can be relegated to four main areas which include the acquisition of collections and their management, identification of specimens, training of personnel and publication of research papers.

1. Acquisition of collections and their management. At the start of the project in 1964, the National Museum of Natural History possessed

several thousand specimens of Southeast Asia mosquitoes which were primarily collected by earlier workers (D. C. and E. B. Thurman, O. R. Causey, E. I. Coher and P. F. Beales) in Thailand. In addition, a small amount of material resulting from World War II collections in the CBI Theater of operations had been deposited here. These collections were obviously inadequate for the type of work proposed and arrangements were made with various organizations to either collect specimens to meet the requirements of the project or loan or donate material from existing collections for long-term study.

The nucleus of the collection consists of over 79,000 specimens collected by personnel of the SEATO Medical Research Laboratory (U. S. Component) in Bangkok, Thailand under the direction of LTC J. E. Scanlon and Dr. D. J. Gould. Another important segment comprises 50,000 specimens from Malaysia which were collected by Dr. S. Ramalingam of the University of Malaysia with the assistance of a U. S. Army Medical and Research Command grant. These two collections are not only important due to the total number of specimens but also due to the fact that most species are represented by reared series consisting of associated larval and pupal skins, and associated adult mosquitoes. This type of material was essential for the success of the project. Other significant sources of material are enumerated in Appendix 4 which shows the accessions which consisted of 200 or more specimens. Various components of the U. S. Armed Forces provided much significant material which could not be obtained elsewhere. The collections of the British Museum (Natural History) were especially valuable as they contained much of the older type material which was required for identification of many of the species.

During the period of this contract, over 200,000 specimens (Appendix 5) were accessioned by the project. Within the next few years, a large proportion of this material will be incorporated into the national collections which will give the Smithsonian Institution the most complete coverage for this portion of the world.

2. Identification of specimens. Over the past decade, the staff and collaborators of the project have been recognized as a source for accurate identification of the mosquito fauna of the Oriental region. Through their efforts, many thousands of specimens of critical epidemiological interest to the U. S. military services, public health officials of both national and international organizations and scientists throughout the world have received prompt identification. This has provided invaluable reference material for investigations on malaria, filariasis, the dengues and other arbovirus infections.

3. Training of personnel. During the first few years of the project, approximately 20 military entomologists received specialized training for periods of up to two weeks. This enabled them to conduct preliminary identification of specimens in the field and to ascertain which material should be sent to Washington for further study. Considerable time was saved in the project by this procedure.

To assist in the above training procedure, the staff prepared a guide entitled, "Preliminary keys to the mosquitoes of Vietnam" in 1966. The main purpose of this manual was to aid trainees in Washington and military entomologists in overseas laboratories in the identification of the common vector mosquitoes with a fair degree of accuracy.

The most significant aspect of this training has involved the assignment of military entomologists to the Walter Reed Army Institute of Research who have studied biosystematic procedures with the assistance of the resident staff and have conducted their research at the Smithsonian Institution. Through this mechanism, the Army Medical Service has received significant benefits, and in turn, these officers have provided 40 of 101 publications of the project.

4. Publication of research papers. The results of the investigations of the staff have been summarized in the 101 publications listed in the bibliography (Appendix 3). Details concerning the research involved has been described in the previous Annual Progress Reports of the Southeast Asia Mosquito Project.

It is difficult to assess the practical importance of the scientific work which has been published, as often much of the biosystematic information present in the "Contributions" series only becomes of epidemiological value during the investigation of a disease epidemic many years subsequent to publication. However, this research is initially needed, as material which had hitherto been referred to as Aedes sp. or Culex sp. can now be identified with a high degree of accuracy. Appendix 6 provides some indication of the major changes which have occurred in the taxonomy of Southeast Asia mosquitoes through the publications of the staff. It may be seen that 80 new mosquito species and 2 new subgenera have been described by this group. In addition, hundreds of changes were made in the assignment of species to the correct taxonomic categories which cannot be indicated by such a table. A brief analysis of the Contributions series shows that as of May 1974, 233 species had received monographic treatment.² It is anticipated that an additional 200 species will receive this type of treatment when publications currently in preparation will be completed. Thus, most of the important vector groups will have been reviewed during the period of this contract.

2

Monographic treatment of a species includes a thorough description of an undescribed or a known species covering the larval, pupal and adults of each sex; all available data on distribution, bionomics and medical significance; keys for the identification of all members of the group to which it belongs, diagnoses of species groups, complexes and higher taxonomic groups at the generic and subgeneric level and usually 3 plates of illustrations for each species encompassing adult habitus, larval and pupal chaetotaxy, male and/or female genitalia and often a distribution map.

In addition to the overall accomplishments described above, certain papers have added significantly to our knowledge of mosquitoes. These are briefly cited below in chronological sequence.

- (a) Ecological studies of Culex quinquefasciatus in relation to the epidemiology of bancroftian filariasis in Rangoon, Burma (de Meillon et al, 1967).
- (b) Discovery of a new anopheline species in Thailand (Scanlon and Peyton, 1967).
- (c) Review of the genus Culex in Thailand (Bram, 1967).
- (d) Preparation of an annotated checklist of Anopheles of Thailand (Scanlon et al, 1968).
- (e) Discovery of a potential dengue vector in Thailand and its separation from Aedes aegypti and Ae. albopictus (Huang, 1969).
- (f) Revision of the Anophelinae of Africa, south of the Sahara (Cillies and de Meillon, 1968).
- (g) Preparation of a mosquito taxonomic glossary to assist in the formulation of a uniform system of describing mosquito structure (Knight and Laffoon, 1970-73).
- (h) Revision of the genus Feizmannia in Southeast Asia (Mattingly, 1970).
- (i) Proposed reclassification of subgenus Neoculex of Culex (Sirivanakarn, 1971).
- (j) Preparation of illustrated keys to the genera of mosquitoes of the world (Mattingly, 1971).
- (k) Separation of genus Uranotaenia into subgenera (Peyton, 1972).
- (l) A new interpretation of the Anopheles hyrcanus complex of Southeast Asia (Harrison, 1972).
- (m) Revision of subgenus Eumelanomyia of Culex in Southeast Asia and adjacent areas (Sirivanakarn, 1972).
- (n) Revision of Aedes scutellaris group of Stegomyia in Southeast Asia (Huang, 1972).
- (o) Redescription of Anopheles sinensis and a review of its vector status in Southeast Asia (Harrison, 1973).
- (p) Revision of subgenus Aedimorphus of Aedes in Southeast Asia (Reinert, 1973).

- (q) Discovery of a new species of Aedes (Stegomyia) from Thailand (Huang, 1973).
- (r) Discovery of a new anopheline species in Sri Lanka (Ceylon) (Harrison, 1973).
- (s) Description of a new subgenus of Aedes from Southeast Asia (Reinert, 1973).

REVIEW OF PROGRESS FOR THE PERIOD OCTOBER 1973 TO MAY 1974

Progress of the individual investigators is detailed below. In addition, significant progress was achieved by a consultant, Dr. Shivaji Ramalingam, on the genus Armigeres during a 3-week visit to the project during February 1974. The revision of the genus Tripteroides, by Dr. Peter Mattingly of the British Museum continued to show progress.

Genus Aedes (MAJ John F. Reinert, MSC)

A manuscript has been completed on a new interpretation of the subgenus Verrallina of Aedes which is confined to the Oriental, Australian and Oceanic regions. Verallina is redescribed and the 90 included species assigned to section and series categories. Considerable new information on the biology, distribution, descriptions, synonymy and corrections to published species is presented. Four new species and numerous previously undescribed stages are covered. Nine new synonyms, one species resurrection, and 5 lectotypes are designated in this paper.

A monograph on the new subgenus Bothaell of Aedes was published. This paper included descriptions and illustrations of all known stages of the 3 included species, all 3 species which were new.

Unnamed setae on the larval cervical membrane were reported. Their taxonomic importance and possible phylogenetic significance were discussed with special reference to Aedes subgenera Finlaya and Ochlerotatus.

A paper was published outlining the detailed procedures for preparing and dissecting the female genitalia of aedine mosquitoes for taxonomic examination. A taxonomic glossary of the female genitalia of mosquitoes was also presented and all significant structures illustrated.

Work is approximately one half finished on a comparative study of the female genitalia of the 37 subgenera of Aedes. These studies indicate that the female genitalia of the tribe Aedini are of taxonomic value at the generic, subgeneric and species group levels. Descriptions have been completed for 52% of the subgenera and illustrations of 67% of the subgenera.

Some progress has been made on a revision of the subgenus Aedimorphus in the Oriental, Australian and Pacific Islands areas. Work is continuing on revisions of Aedes subgenera Paraedes and Edwardsaedes.

Genus Aedes, Subgenus Stegomyia (Yiau-Min Huang)

It is now planned to combine the remaining 5 species groups of the subgenus Stegomyia of Southeast Asia in a single revision. This study covers about 23 species and subspecies. Manuscript and illustrations of two species groups (Groups D and H) have been completed. A third species group (Group B) is underway. 40% of the manuscript and 20% of the illustrations have been made. During this period, three short papers have been submitted for publication.

From October 1973 to May 1974, 77 lots of eggs of the scutellaris group were received from Pangaimotu Is., Ha'ano Is., Fiji Is. and Eua Is. in the South Pacific. All of the eggs received from Dr. James Hitchcock (World Health Organization) were hatched at SEAMP. Progeny rearings were carried out and the adult specimens with associated skins of larvae and pupae were prepared at SEAMP for taxonomic studies. A total of 582 adults with associated larval and pupal skins and 239 whole 4th instar larvae were obtained. Some of the eggs were given to Dr. Lloyd Rozeboom (Johns Hopkins University) for establishing colonies for genetic and related studies. In addition to the eggs, 321 adults with associated larval and pupal skins (unmounted) were received from the South Pacific.

The taxonomic study of the scutellaris group of the South Pacific has been concentrated mainly in the Tonga area. 50% of the adults from the Tonga area have been examined which includes the preparation of male terminalia.

Genus Uranotaenia (E. L. Peyton)

Some progress was made on the Uranotaenia of Southeast Asia with the greatest emphasis placed upon the bionomics and taxonomic discussions. Descriptions of several species were revised and two newly described species from the Ryukyu Islands were added. Three additional illustrations were completed. A separate manuscript was completed on a new species of Uranotaenia from Sri Lanka.

Assistance was furnished to Dr. Kazuo Tanaka, U. S. Army Laboratory, Pacific in his study of specimens from the Ryukyu Islands. Several adult and immature stages of 4 species of Uranotaenia were analyzed (including larval and pupal chaetotaxy) and compared with 15 species from Southeast Asia. It was determined that two undescribed species occurred on these islands. Material and descriptive data were provided to Dr. Tanaka to assist in the characterization of his new species. This resulted in a manuscript which was received for review.

The annotated check list of the mosquitoes of the Smithsonian Sri Lanka expedition collections was completed with the collaboration of other staff members. During the period 1970-73, 64 taxa of Culicidae were collected. Several species represented new records for Sri Lanka.

Several Philippine specimens of Uranotaenia and Anopheles were identified for the U. S. Air Force, First Medical Service Wing. The specimens were representatives of species included in a manuscript on a mosquito survey of Dumaguete, Philippines by R. G. Basio in 1969. These identifications enabled significant revisions to be made to the original manuscript.

Genus Culex (Sunthorn Sirivanakarn)

About 25 of the 43 species of the subgenus Culex from Southeast Asia have been treated in the first draft of this revision. This draft contains a taxonomic review of the subgenus, characterization of species groups, sub-groups and complexes, description of all known stages, lists of specimens and distribution, taxonomic synonymies, type data, discussion in systematics and a summary of the bionomics and disease relationships. The keys to all known stages of every species have been completed except for some modifications which include the selection of the best diagnostic characters.

For the illustrations, about 55 of the 75 plates have been completed; 10 are in preliminary sketches and 10 remain to be done. The last category includes mostly drawings of the male genitalia, pattern of wing spots, female genitalia and cibarial armature. Drawings of the pupae and larvae are almost complete except for about 5 species which are in preparation.

The manuscript of the revision of the subgenus Lophoceraomyia which includes 58 species is almost in the form of a final draft. Of a total of 62 scheduled plates, 26 have been completed, 11 are in the form of preliminary sketches and 25 remain to be drawn.

Genus Aedes, Subgenus Christophersiomyia (CPT Jay Abercrombie, MSC)

The subgenus Christophersiomyia occurs throughout tropical Asia and the southwestern Pacific Islands. A taxonomic revision of the 6 known species was conducted. All specimens including immature stages and male genitalia mounted on slides in the SEAMP and USNM Collections were examined. New distribution records added greatly to the known geographic ranges of 4 of the species.

Preliminary descriptions of adult females and male genitalia of 4 species were made. Work was initiated on descriptions of previously undescribed immature stages and in writing improved descriptions for others described in the early literature. Illustrations of adults of 4 species have been completed. Illustrations of larvae and pupae were begun by the illustrator assigned to this work.

In addition to this revisionary study, approximately 7 weeks were devoted to identifying about 2800 specimens of Culicidae collected from an endemic focus of Venezuelan Equine Encephalitis in Guatemala by Dr. William F. Scherer, Cornell University Medical College during 1973.

Genus Anopheles (CPT Bruce A. Harrison)

The third draft of the manuscript of the subgenus Anopheles of Thailand was completed. This involved the examination of over 10,000 specimens of 32 species and one subspecies. Ninety-six full-page plates were prepared which included figures of whole pupae and larvae, many habitus drawings of females, male genitalia, wings and other selected characters. Major sections included are: zoogeography, morphology, taxonomy of supraspecific categories, keys and the descriptions. It is anticipated that the final draft of this revision will be completed early in 1975.

Anopheles insulaeflorum as previously recognized, was shown to be two species which can be differentiated by larval, pupal and male genitalia characters. The new species, which occurs in the Philippines and eastern Indonesia was named Anopheles pilinotum Harrison and Scanlon.

It is anticipated that the above described studies, with the exception of some of the smaller subgenera of Aedes, i.e., Paraedes and Edwardsaedes, and the review of Aedes scutellaris group of the Southwest Pacific will be completed during 1975.

RECOMMENDATIONS

In retrospect, the original objectives of the project were far too broad in terms of the specimens and personnel available to conduct the research. This became evident during the period that Dr. Botha de Meillon served as Principal Investigator (1966-73). Several of the collaborators either retired or assumed so many administrative duties that they were no longer able to conduct the planned research or achieve completion within the ten year period of the project. Thus, it became necessary to redefine the objectives and restrict the coverage of research during the final years of the project to genera and subgenera of known vectorial importance.

It is recommended that future biosystematic projects establish realistic goals which can be completed within a designated time period. The selection of taxa for review should be based upon their significance as vectors of pathogens and the availability of specimens for study. Although the concept of research collaborators is a good one, the presence of a strong resident in-house staff is the optimal method of achieving project objectives on schedule. Productivity of military entomologists assigned to the project has been exceptionally high and it is recommended that their participation in future projects be continued.

Appendix 1.

PERSONNEL RECEIVING CONTRACT SUPPORT

<u>Name</u>	<u>Dates of Service</u>	<u>Organization</u>
* Dr. Alan Stone	10/1/64 - 12/31/71	USDA
* LTC John E. Scanlon	10/1/64 - 3/31/69	WRAIR
Calesta C. Lipscomb	10/14/64 - 6/2/67	SI
Thelma L. Ford	11/22/64 - 5/31/74	SI
Manop Rattanaarithikul	12/21/64 - 3/11/66	SI
* CPT Donald L. Bailey	12/29/64 - 7/30/65	WRAIR
J.P. Macnamara	1/17/65 - 7/23/65	SI
A.O. Uter	1/18/65 - 8/12/66	SI
* Dr. Ralph A. Bram	1/31/65 - 10/21/67	SI
Hattie L. Simmons	3/8/65 - 2/10/67	SI
* Dr. Mercedes D. Delfinado	6/15/65 - 9/29/67	SI
Rampa Rattanaarithikul	9/8/65 - 3/1/66	SI
* Dr. Botha de Meillon	3/9/66 - 4/28/73	SI
Virginia M. Ford	11/30/65 - 5/31/74	SI
Elaine R. Taylor Hodges	2/20/66 - 8/15/69	SI
C. John Lane	5/28/66 - 1/21/72	SI
Karen Humphries Prather	11/1/66 - 9/8/67	SI
Lotte B. Schiff	5/21/67 - 5/31/74	SI
Jung L. Hwang Smith	11/30/65 - 8/11/67	SI
* Dr. Yiau-Min Huang	10/1/67 - 5/31/74	SI
Mary T. Houck Fowler	3/8/65 - 8/23/68	SI
Vichai Malikul	7/2/67 - 5/31/74	SI
* E.L. Peyton	7/10/67 - 8/31/68	WRAIR
	9/1/68 - 5/31/74	SI
Robert Hochman	7/10/67 - 1/31/69	WRAIR
	6/18/73 - 5/31/74	SI
Ann L. Hoskins Dery	10/5/67 - 5/31/74	SI
* MAJ John F. Reinert	1/8/68 - 9/1/68	WRAIR
	8/10/71 - 5/31/74	WRAIR
Carolyn Ann Seabron	6/17/68 - 8/26/69	SI
* Dr. Sunthorn Sirivanakarn	7/28/68 - 5/31/74	SI
* CPT William H. Tyson	11/21/68 - 6/30/71	WRAIR
Yvonne Lee	12/1/68 - 1/22/72	SI
Phuang Thong Malikul	1/26/69 - 9/19/71	SI
Lawrence M. Druckenbrod	6/1/69 - 11/27/71	SI
* CPT Bruce A. Harrison	8/1/70 - 12/1/73	WRAIR
Gloria E. Gordon	10/4/71 - 5/31/74	SI
Sheila E. Ford	4/9/72 - 7/28/72	SI
Shuling Tung	1/24/72 - 1/6/73	SI
Carolyn M. Emerick	1/9/72 - 3/16/74	SI
Thomas V. Gaffigan	10/17/71 - 5/31/74	SI
Anita L. Schmidt	1/2/72 - 9/12/72	SI
Margaret H. Gaffigan	2/6/72 - 8/17/73	SI
Janet D. Rupp	5/28/72 - 5/31/74	SI
Helle Starcke	5/28/72 - 5/31/74	SI

* Entomologist

Appendix 1.

PERSONNEL RECEIVING CONTRACT SUPPORT

<u>Name</u>	<u>Dates of Service</u>	<u>Organization</u>
Young T. Sohn	11/1/72 - 5/31/74	SI
Suzanne Chien C. Chang	1/7/73 - 5/31/74	SI
Albert E. Giraldi	10/1/72 - 3/30/73	SI
Susan Hevel	8/19/73 - 5/31/74	SI
Constance L. Anderson	6/6/73 - 3/16/74	SI
Penelope B. Smallwood	9/1/74 - 5/31/74	SI
* CPT Jay Abercrombie	10/15/73 - 5/31/74	WRAIR
* Dr. Ronald A. Ward	1/2/74 - 5/31/74	WRAIR
Owilda J.R. Curtis	3/26/74 - 5/31/74	SI

SOUTHEAST ASIA MOSQUITO PROJECT CONSULTANTS

Professor Kenneth L. Knight, North Carolina State University, Raleigh,
N.C. - Aedes (Finlayia) and mosquito glossary (1966-74).

Dr. Peter F. Mattingly, British Museum(Natural History), London, England
- Heizmannia, Tripteroides and generic key to mosquitoes (1966-74).

Dr. Shivaji Ramalingam, University of Malaya, Kuala Lumpur, Malaysia -
Armigeres and Culicidae of Malaysia (1966-74).

Dr. Douglas J. Gould, SEATO Medical Research Laboratory, Bangkok, Thailand,
Culicidae of Thailand (1964-1974).

Professor John E. Scanlon, School of Public Health, University of Texas,
Houston, Texas - Anopheles (1969-74).

Dr. Thomas Zavortink, University of California, Los Angeles, Calif. -
Orthopodomyia (1966-71).

Dr. Alan Stone, Systematic Entomology Laboratory, U.S.Department of Agricul-
ture, Washington, D.C. Culicidae of Southeast Asia (1966-72).

Dr. J.M. Klein, ORSTOM, Dakar, Senegal - Culex(Mochthogenes) and Aedes
(Neomacleaya) (1967-74).

Dr. J. Bonne-Wepster, Amsterdam, The Netherlands - Toxorhynchites (1967-69).

Dr. N.V. Dobrotworsky, University of Melbourne, Australia - Culiseta (1969-71).

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Appendix 4.

MAJOR ACCESSIONS OF THE SOUTHEAST ASIA MOSQUITO PROJECT

	<u>Source</u>	<u>No. of Specimens</u> *
1.	SEATO Medical Research Laboratory Bangkok, Thailand	79,113
2.	Dr. S. Ramalingam, University of Malaya, Kuala Lumpur, Malaysia	50,085
3.	5th Epidemiological Flight, USAF, Philippines	8,470
4.	20th Preventive Medicine Unit, USA , Republic of Vietnam	7,450
5.	National Museum, Manila, Philippines	6,750
6.	SEAMP Field Trip, Philippines	6,336
7.	Philadelphia Academy of Natural Sciences, Philadelphia, Pennsylvania	6,238
8.	Preventive Medicine Division, U.S. Navy	5,073
9.	9th Medical Laboratory, USA, Republic of Vietnam	5,313
10.	Field Museum of Natural History, Chicago, Illinois	4,730
11.	World Health Organization Filariasis Project, Tonga	4,209
12.	U.S. Army Medical Research Unit, Kuala Lumpur, Malaysia	3,591
13.	British Museum(Natural History), London, England	3,561
14.	U.S. Army Laboratory, Ryukyus	2,626

* Includes adults, slides of immature stages, vials of unmounted immatures

15.	Bernice P. Bishop Museum, Honolulu, Hawaii	2,606
16.	Dr. J. Bonne-Wepster, Amsterdam, Netherlands	2,270
17.	Naval Medical School, Bethesda, Maryland	1,482
18.	Dr. J.N. Belkin, University of California, Los Angeles, California	1,282
19.	Public Health Service, Honolulu, Hawaii	866
20.	Dr. Mercedes Delfinado, Honolulu, Hawaii	864
21.	Mr. K. Frogner, University of Chicago, Chicago, Illinois	704
22.	Tunghai University, Taichung, Taiwan	692
23.	Dr. J.M. Klein, Dakar, Senegal	691
24.	Institute Pasteur, Saigon, Republic of Vietnam	627
25.	University of Singapore, Singapore	564
26.	406th Medical General Laboratory, Tokyo, Japan	405
27.	Mr. B.N. Mohan, Coonoor, India	398
28.	Dr. Kenneth L. Knight, North Carolina State Uni- versity, Raleigh, North Carolina	306
29.	Dr. F.Y. Cheng, World Health Organization, Sabah Malaysia	301
30.	Mr. Cheong Cheong, Minsante, Cambodia	294
31.	South African Institute for Medical Research, Johannesburg, South Africa	271
32.	ORSTOM, Bondy, France	257

Appendix 5.

SUMMARY OF ACCESSIONS FROM 1 OCTOBER 1964 to 31 MAY 1974

396 Different accessions:

47 lots of unmounted immatures
62 lots of unmounted adults
211 lots of eggs for rearing
3,087 unmounted adults
15,393 unmounted immatures
79,792 slides
110,857 adults
<hr/>
209,449 Total specimens

Appendix 6.

NEW TAXA DESCRIBED BY THE SOUTHEAST ASIA MOSQUITO PROJECT.

1. Culex(Thaiomyia) dispectus Bram 1966
2. Culex(Lophoceraomyia) spiculosus Bram and Rattanakrithikul 1967
3. " " peytoni " " " "
4. " " eukrines " " " "
5. " " pholeter " " " "
6. " " fuscospionis " " " "
7. " " incomptus " " " "
8. Anopheles(Anopheles) tigertti Scanlon and Peyton 1967
9. Aedes(Neomacleaya) cretatus Delfinado 1967
10. " " gibbosus " " "
11. " " hispidus " " "
12. " " latipennis " " "
13. " " notabilis " " "
14. " " protuberans " " "
15. " " torosus " " "
16. Culex(Culiciomyia) barrinus Bram 1967
17. " " scanloni " " "
18. " " spiculothorax " " "
19. " " thurmanorum " " "
20. " (Culex) neolitoralis Bram 1967
21. Aedes(Neomacleaya) pahangi Delfinado 1968
22. " " philippinensis Delfinado 1968
23. " " rarus Delfinado 1968
- 23a. " " siamensis " " "
24. Tripteroides(Tripteroides) denticulatus Delfinado and Hodges 1968
25. " " malayi " " " "
26. " " tarsalis " " " "
27. Aedes(Stegomyia) seatoi Huang 1969
28. Ficalbia (Ravenalites) kiriromi Klein 1969
29. Anopheles(Cellia) vernus Gillies and de Meillon 1968
30. " " fontinalis " " " "
31. " " murphyi " " " "
32. Aedes(Finlaya) mohani Knight 1969
33. Culex(Mochthogenes) kiriensis Klein and Sirivanakarn 1969
34. " " otachati " " " "
35. " " bokorensis " " " "
36. " " selai " " " "
37. Heizmannia(Heizmannia) demeilloni Mattingly 1970
38. " " persimilis " " "
39. " " propinqua " " "
40. " " proxima " " "
41. " " scanloni " " "
42. " (Mattinglyia) thelmae " " "
43. Uranotaenia rampae Peyton and Klein 1970
44. " diraphati " " " "
45. " koli " " " "
46. " gouldi " " " "
47. " sambooni " " " "

48. Aedes(Diceromyia) scanloni Reinert 1970
49. Uranotaenia demeilloni Peyton and Rattanaarithikul 1970
50. " prajimi " " " "
51. " pseudomaculipleura Peyton and Rattanaarithikul 1970
52. " spiculosa Peyton and Rattanaarithikul 1970
53. " sumethi " " " "
54. Culex(Neoculex) richei Klein 1970
55. " (Eumelanomyia) malayensis Sirivanakarn 1972
56. " " phangngae " "
57. " " baisasi " "
58. Aedes(Stegomyia) alcasidi Huang 1972
59. Aedes(Ayurakitia) peytoni Reinert 1972
60. Aedes(Aedimorphus) gouldi Reinert 1972
61. Culex(Culiciomyia) lampangensis Sirivanakarn 1973
62. " " delfinadoae " "
63. " " ramalingami " "
64. Culex(Lophoceraomyia) submarginalis " "
65. " " castaneus " "
66. Aedes(Stegomyia) malikuli Huang 1973
67. Culex(Culiciomyia) ceramensis Sirivanakarn and Kurihara 1973
68. Anopheles(Anopheles) reidi Harrison 1973
69. Aedes (Neomacleaya) consonensis Reinert 1973
- 69a. Aedes (Neomacleaya) khmerus Klein 1973
70. " " kompongus " "
71. " " phnomus " "
72. " " stungus " "
73. Aedes(Diceromyia) pseudonummatus Reinert 1973
74. Aedes(Bothaella) helenae Reinert 1973
75. " " eldridgei Reinert 1973
76. " " kleini " "
77. Anopheles(Anopheles) nitidus Harrison, Scanlon and Reid 1973
78. Anopheles(Anopheles) palinotum Harrison and Scanlon 1973
79. Culex(Thaionomyia) bram 1966
80. Aedes (Bothaella) Reinert 1973